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**MATHEMATICAL ANALYSIS OF BIBLIOMETRICAL
INDICES OF INVESTIGATIONS OF INFLUENCE OF
NON-IONIZED RADIATION OF DIFFERENT KINDS
UPON NEURONS (MEDLINE-INTERNET)**

Biological effects of non-ionized radiation interest people for many centuries and even thousand years. [1]. In the middle XX-th century in consequence of appearance of new technological approaches investigations of this trend were facilitated. Russian researches (including the author of the present work) made essential contribution to development of this problem.

In indicated trend the greatest importance belongs to neurophysiological studies since the nervous system is of great significance in reactions of organism to non-ionized radiation of different kinds [2-10]. Our pioneering investigations established a key role of influence these penetrating factors on the nervous tissue in the rearrangements functional systems of animals and humans to them.

Bibliometrical investigation of published material on biological effects of non-ionized radiation including neurophysiological aspects was not carried out up to now. Therefore we tried to consider bibliometrical characteristics of investigations on the indicated trend.

Information accumulated in world on these trends during 35-year period in the later half of the XX century (1966-2000) was considered. Quantitative characteristics of publications on biological effects of non-ionized radiation of different kinds: electromagnetic (EMF), magnetic (MF), and electrical (EF) fields. Moreover especially biological effects of microwaves (MW) were selected because this factor was in the center of attention of researchers in the middle of the XX-th century.

Certain data on the problem of the bibliometrical analysis of published works were considered in our recent papers [11-17] and monograph [18]. The present paper is devoted to examination of bibliometrical characteristics of works concerning action of non-ionized radiation of different kinds on neurons.

Bibliometrical investigation of published works was carried out by means of the database "Medline" accessible in Internet. Published works concerning effects of EMF, MW, MF, and EF on condition and functions of neurons were examined. Quantitative characteristics of the number of these published works during 35-year period in the later half of the XX century (1966-2000) were analyzed.

For statistical analysis of the obtained data coefficient of correlation, usual Student *t*-test for comparison of mean values, another Student *t*-test and Wilcoxon test for conjugate pairs were used. Besides the comparison of

sampling fractions (%) of works carried out with different factors in general totality were performed by *t*-criterion for selective fractions of variants.

The number of published works on biological effects of non-ionized radiation during 35-years period from 1966 till 2000 reached 21606. From them only 5935 ones were carried out on neurophysiological objects (27.47 %). But from the latter 770 works were made on neuronal level (12.97%).

General quantitative characteristics of values of published works carried out on neuronal level with application of non-ionized radiation of different kinds (EMF, MW, MF and EF) are demonstrated in table 1. Mathematical comparison of the numbers of published works of indicated trends is presented in table 2.

The table 1 presents general quantitative characteristics of published works about action of EMF, MW, MF, and EF neurons. This table shows significant predominance published works with application of EMF, that takes place at investigation of effects of radiation upon the whole brain and the cortex [11, 12]. The numbers of works with another factors are relatively similar. In contradistinction to cases of investigations in the whole brain and the cortex, the number of works on effects of EF is rather high [11, 12].

The table 2 shows positive correlation between the numbers of works carried out on nervous level with all applicable penetrating factors. Moreover mean value of cases with EMF significantly differs from the same with MW and MF and nearly with EF. Application of tests for conjugate pairs shows significantly distinctions between data with EMF and with another factors. Results of comparison of sampling fractions (%) from the total number of works confirm significant predominance of published works on action of EMF, presented in table 1.

Table 1.

General data on the number of published works carried out with different kinds of non-ionized radiation in neurons during 35-year period

Factors	Characteristics of totalities					
	Total number for 35 years	Mean values over 1 year	Variance	Sigma	Standard deviation	Fraction (%) in general totality
1	277	7.91	70.85	8.42	1.42	35.97
2	165	4.71	17.09	4.13	0.70	21.43
3	152	4.34	23.35	4.83	0.82	19.74
4	176	5.03	22.97	4.79	0.81	22.86
5	770	22.00	388.94	19.72	3.33	100.00

Application: 1 - EMF, 2 - MW, 3 - MF, 4 - EF, 5 - sum.

Table 2.

Comparison of quantitative indices of published works carried out with different kinds non-ionized radiation in neurons during 35-year period

Factors	Comparison of totalities				
	Coefficient of correlation	Student <i>t</i> -test for mean values	Student <i>t</i> -test for conjugate pairs	Wilcoxon test for conjugate pairs (<i>U</i>)	Comparison of fractions in general totality(<i>U</i>)
1 c 2	<u>0.68</u>	<u>2.02</u>	<u>2.98</u>	<u>2.83</u>	<u>6.38</u>
1 c 3	<u>0.74</u>	<u>2.18</u>	<u>3.62</u>	<u>3.47</u>	<u>7.18</u>
1 c 4	<u>0.85</u>	1.76	<u>3.40</u>	<u>2.62</u>	<u>5.71</u>
2 c 3	<u>0.43</u>	0.35	0.46	0.67	0.80
2 c 4	<u>0.63</u>	0.29	0.48	0.01	0.67
3 c 4	<u>0.78</u>	0.60	1.27	1.19	1.47

Application: significant values of coefficients of correlation and statistically significant distinctions between distributions and between sampling fractions are underlined ($r > 0.435$ corresponds to $p < 0.01$; t and $U > 1.96$ corresponds to $p < 0.05$ and > 2.58 corresponds to $p < 0.01$); the other designations as in table 1.

Dynamics of the numbers of published works of all considered kinds during 35-year period were them increase, that took place at works performed on the brain and the cortex [16, 17]. But dynamics of sampling fractions of published works on these trends were different. Prevailing increase of sampling fraction of works on action of MW was in 70-80 years. Similar pattern of dynamics of sampling fractions of published works with MW was noted at works carried out the brain and the cortex [16, 17].

Obtained data show that among published works carried out on neuronal level with application of non-ionized radiation the works on action of EMF prevail, but to lesser extend than in the case of works on the brain and the cortex [16, 17]. Moreover the numbers of published works on neurons with MW, MF, and EF have similar values, which differ these results from the same on the brain and the cortex [16, 17]. The numbers of published works with all indicated factors have steadily increase during analyzed period. However dynamics of the sampling fractions (%) of works about considered factors are not identical. Dynamics of works with application of MW possesses specific character and demonstrates them in middle of observed period, as at investigation on the brain and the cortex [16, 17]. The point is that intensity of investigation of any trend is determined by technical equipment of society and special features of use of different kinds of non-ionized radiation in different time periods.

Hence, results of bibliometrical analysis of works carried out on neuronal level with application of non-ionized radiation differ from the same on the whole brain and the cortex in consequence the greater part of works with EM, but are similar with them according by pattern of dynamics of the number of work with MW. The former connects the large number of applied investigation with these factors on the brain and the cortex. Undoubtedly the later is conditioned by technical equipment of society and its needs.

Now unfortunately researches of applied aspects of neurophysiological effects of non-ionized radiation (dosimetrical, hygienic, therapeutic) are in the lead. Fundamental investigations of neurophysiological effects of non-ionized radiation are played no enough attention to. However, fundament neurophysiological investigations of action of non-ionized radiation are necessary for understanding of formation and organization of reaction upon radiation [2, 3, 18]. Investigations on neuronal level are the most valuable [3-10].

Thus at present paper bibliometrical analysis of published works carried out on neuronal level with application of non-ionized radiation of different kinds is present. The special features of quantitative neurons are considered. Mathematical comparison of the numbers of published works of indicated trends is performed. Complex dynamics of number of these works is considered. All representative data are priority.

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Чиженкова Р. О. Математичний аналіз бібліометричних показників досліджень впливу неіонізуючої радіації різних видів на нейрони (Medline-Internet)

Представлено бібліометричні дані за дослідженими дії неіонізуючої радіації різних видів на нейронному рівні. Розглянуто кількісні характеристики публікацій і динаміка показників з 1966 по 2000 р. на основі "Medline".

Ключові слова: бібліометрія, неіонізуюча радіація, нейрони, інтернет.

Чиженкова Р. А. Математический анализ библиометрических показателей исследований влияния неионизирующей радиации разных видов на нейроны (Medline-Internet)

Представлены библиометрические данные по исследованию действия неионизирующей радиации разных видов на нейронном уровне. Рассмотрены количественные характеристики публикаций и динамика показателей с 1966 по 2000 г. на основе "Medline".

Ключевые слова: библиометрия, неионизирующая радиация, нейроны, интернет.

Chizhenkova R. A. Mathematical Analysis of Bibliometrical Indices of Investigations of Influence of Non-Ionized Radiation of Different Kinds Upon Neurons (Medline-Internet)

Bibliometrical data of investigations on action of non-ionized radiation on neuronal level are presented. Number of published works from 1966 to 2000 year were considered by means of the database "Medline".

Key words: bibliometria, non-ionized radiation, neurons, internet.

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